

Claims

1. A process for the hydrogenolysis of a sugar feedstock in the presence of a catalyst comprising:
 - (a) ruthenium or osmium; and
 - (b) an organic phosphine;and wherein the hydrogenolysis is carried out in the presence of water and at a temperature of greater than 150°C.
2. A process according to Claim 1 wherein the sugar feedstock is a feedstock comprising one or more of polyols, alditols, aldoses and polymers of aldoses.
3. A process according to Claim 2 wherein the polymers of aldoses are starch or cellulose.
4. A process according to Claim 2 or 3 wherein the alditols and aldoses suitable for use in the process of the present invention are those being from C₃ to C₁₂.
5. A process according to Claim 4 wherein the alditols and aldoses suitable for use in the process of the present invention are those being from C₃ to C₆.
6. A process according to Claim 1 wherein the feedstock is selected from glucose, sucrose, xylose, arabinose and mannose.
7. A process according to any one of Claims 1 to 6 wherein water is present as the solvent for the reaction.
8. A process according to any one of Claims 1 to 6 wherein the sugar feedstock or the product of the reaction is the solvent and water is added as an additive in the solvent.
9. A process according to any one of Claims 1 to 6 wherein a solvent is used and water is added as an additive in the solvent.

10. A process according to Claim 9 wherein suitable solvents are selected from tetraethyleneglycol dimethyl ether, tetrahydrofuran, amides, lactams, N-methyl caprolactam, N-methyl pyrrolidone, diethyl ether, ethyleneglycol dimethylether, dioxane, 2-propanol, 2-butanol, secondary alcohols and tertiary alcohols
11. A process according to any one of Claims 1 to 10 wherein the ruthenium is provided as a ruthenium compound.
12. A process according to Claim 11 wherein the ruthenium compound is a nitrate, sulphate, carboxylate, beta diketone, and carbonyls.
13. A process according to any one of Claims 1 to 12 wherein the ruthenium is present in an amount of from 0.0001 to 5 mol as ruthenium per liter of reaction solution.
14. A process according to any one of Claims 1 to 13 wherein the phosphine is selected from mono, bi and tridentate phosphines.
15. A process according to any one of Claims 1 to 14 wherein the phosphine is selected from trialkylphosphines, dialkylphosphines, monoalkylphosphines, triarylphosphines, diarylphosphine, monoarylphosphines, diarylmonoalkyl phosphines and dialkylmonoaryl phosphines.
16. A process according to Claim 15 wherein the phosphine is selected from tris-1,1,1-(diphenylphosphinomethyl)methane, tris-1,1,1-(diphenylphosphinomethyl)ethane, tris-1,1,1-(diphenylphosphinomethyl)propane, tris-1,1,1-(diphenylphosphino-methyl)butane, tris-1,1,1-(diphenylphosphinomethyl)2,2dimethylpropane, tris-1,3,5-(diphenylphosphino-methyl)cyclohexane, tris-1,1,1-(dicyclohexylphosphinomethyl)ethane, tris-1,1,1-(dimethylphosphinomethyl)ethane, tris-1,1,1-(diethylphosphinomethyl)ethane, 1,5,9-triethyl-1,5,9-triphosphacyclododecane, 1,5,9-triphenyl-1,5,9-triphosphacyclododecane, bis(2-diphenylphosphinoethyl)phenylphosphine, bis-1,2-(diphenylphosphino)ethane, bis-1,3-(diphenyl phosphino)propane, bis-1,4-(diphenyl

phosphino)butane, bis-1,2-(dimethyl phosphino)ethane, bis-1,3-(diethyl phosphino)propane, bis-1,4-(dicyclohexyl phosphino)butane, tricyclohexylphosphine, trioctyl phosphine, trimethyl phosphine, tripyridyl phosphine and triphenylphosphine

17. A process according to Claim 13 wherein the phosphine is a tridentate phosphine.
18. A process according to Claim 17 wherein the tridentate phosphine is tris-1,1,1-(diarylphosphinomethyl)alkane or tris-1,1,1-(dialkylphosphinomethyl)alkane
19. A process according to any one of Claims 1 to 18 wherein the phosphine compound is present in an amount of from 0.0001 to 5 mol as phosphine per liter of reaction solution.
20. A process according to any one of Claims 1 to 19 wherein a base is added.
21. A process according to Claim 20 wherein the base is an amine.
22. A process according to any one of Claims 1 to 21 wherein a second phosphine is added to increase the selectivity.
23. A process according to Claim 22 wherein the second phosphine is one being more weakly coordinating than the phosphine.
24. A process according to any one of Claims 1 to 23 wherein the temperature is from about 190°C to about 260°C.
25. A process according to any one of Claims 1 to 24 wherein the reaction pressure is from about 250 psig to about 2000 psig.
26. A process according to any one of Claims 1 to 25 wherein the sugar feedstock is an aldose and a pre-reduction step is included.

27. A process according to Claim 22 wherein the temperature of the pre-reduction step is from about 150°C to about 250°C.
28. A process according to Claim 26 or 27 wherein the pressure of the pre reduction step is from about 600 to about 1000 psig.
29. A process according to any one of claims 1 to 28 wherein the catalyst is regenerated in the presence of the water and hydrogen.